ORIGINAL

50TP

Tucson Electric Power Company
P.O. Box 711, Tucson, AZ 85702
One South Church Avenue, Suite 200, Tucson, Arizona 85701

January 31, 2008

Docket Control
Arizona Corporation Commission
1200 West Washington Street
Phoenix, AZ 85007

Re: **Docket No. E-00000D-07-0376**

Docket Control:

Enclosed please find an original and thirteen copies of Tucson Electric Power Company's ("TEP") "Ten-Year Plans" pursuant to Title 40, Chapter 2, Article 6.2, "Power Plant and Transmission Line Siting Committee", of the Arizona Revised Statutes. TEP's RMR study, per Staff request, is being provided to Commission Staff directly.

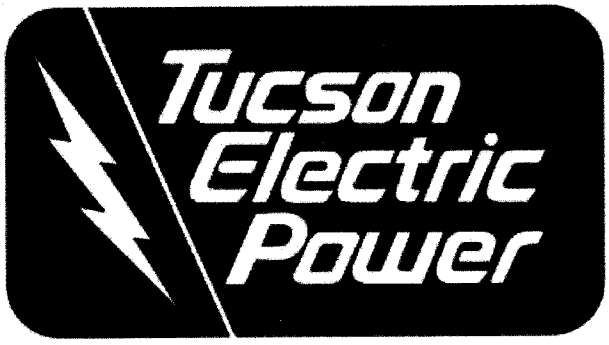
Enclosed is an additional copy of the filing that the Company requests you date-stamp and return in the self-addressed, stamped envelope for our files.

Sincerely,

Jessica Bryne

Jessica Bryne
Regulatory Services

cc: Ernest Johnson, ACC
Prem Bahl, ACC
Ed Beck, TEP
Compliance, ACC (cover letter only)



A UniSource Energy Company

TUCSON ELECTRIC POWER COMPANY

TEN YEAR PLAN

FOR YEARS

2008-2017

SUBMITTED TO THE

ARIZONA CORPORATION COMMISSION

JANUARY 2008

DOCKET NO: **E-00000D-07-0376**

CONTENTS

INTRODUCTION

EHV Transmission System

Tucson Electric Power Company (TEP) is a member of the WestConnect Planning Area and the Southwest Area Transmission Planning Group (SWAT). TEP participates in various SWAT subcommittees including: SWAT Central Arizona Transmission EHV, SWAT Central Arizona HV, SWAT Colorado River Transmission, SWAT Arizona-New Mexico, and Southeast Arizona Transmission System (SATS). Each of these subcommittees has been involved in studying various generation and transmission projects to enhance and increase utilization of the existing system. The SATS study includes all or part of Pima, Pinal, Cochise, and Santa Cruz counties and has the largest direct impact on TEP.

TEP is a participant in the Hassayampa - Pinal West 500 kV project, which will be in service in 2008. TEP's Westwing - South 345 kV line will loop in at the new Pinal West 500/345 kV substation.

TEP is a participant in the Pinal West - Pinal South portion of the Pinal West - Southeast Valley 500 kV project. TEP plans to construct a 500 kV line between the proposed Pinal South Switchyard and TEP's Tortolita Substation in the year 2011.

TEP is evaluating various EHV alternatives for load serving capability within TEP's service territory including a possible 345 kV line between TEP's Tortolita Substation and Vail Substation with a loop in at the North Loop and East Loop Substations. Other alternatives are also being considered that will involve additional HV transmission within TEP's service territory.

138kV Local Transmission System

TEP performs an annual review of its 138kV system performance over a ten-year planning horizon. This results in a schedule for new facilities and upgrades to existing facilities assuring adequate transmission capacity within TEP's service territory as Tucson continues to grow. TEP's 138kV system is improved to accommodate new 138/13.8kV substations, increased line loading, and mitigate localized stability issues.

Load projection analysis looks at distribution system needs and identifies the impact of load growth at each of TEP's distribution substations. This results in proposed new 138/13.8 kV substations and new 138kV transmission lines. Load projection also provides input to the power flow analysis used to identify thermal overloads as Tucson continues to grow.

Power flow analysis looks for thermal overloads during normal and contingency operation based on WECC/NERC Level A, B and C reliability criteria. Contingencies include:

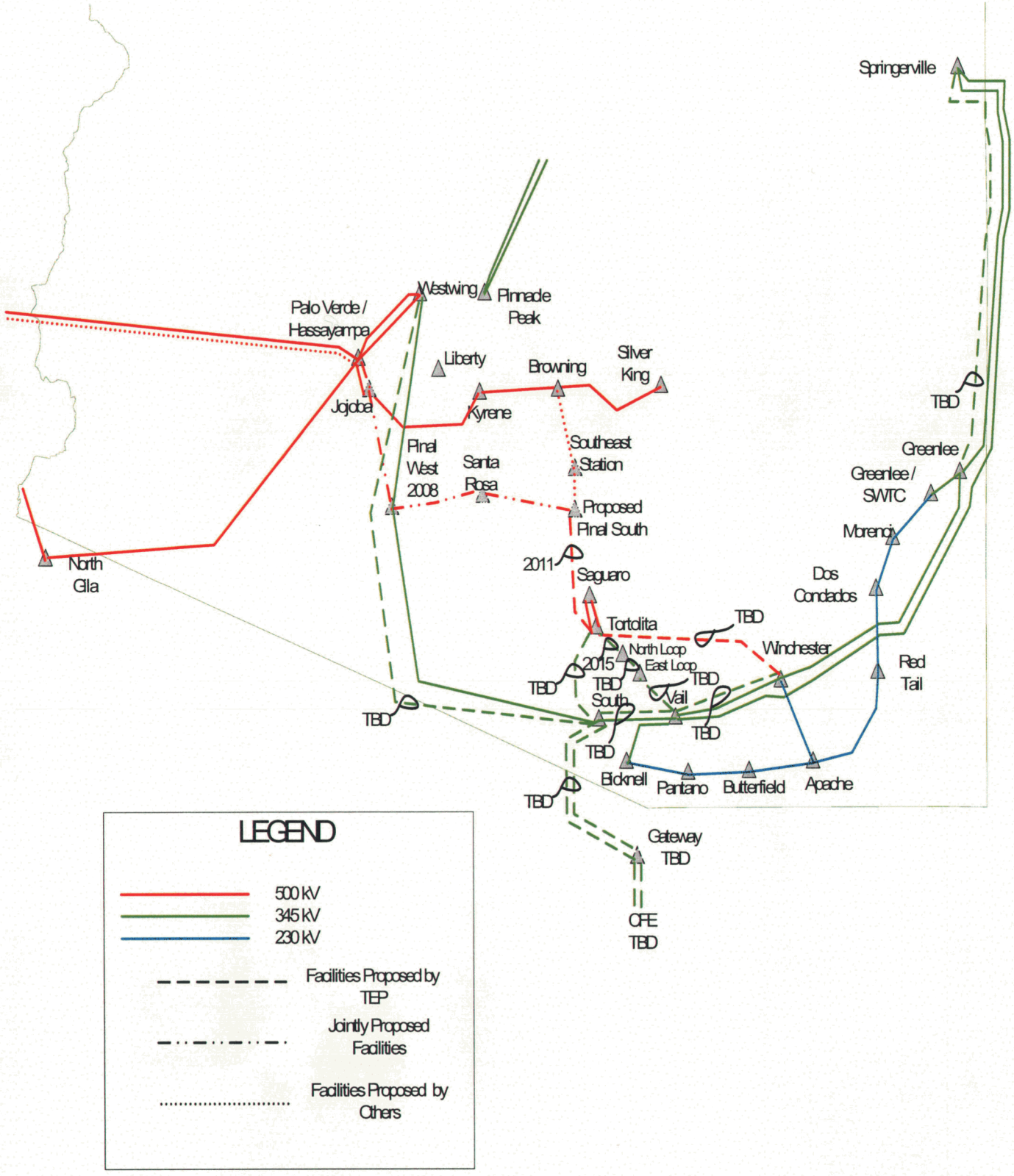
- Loss of major EHV import
- Loss of critical local generation
- Single 138kV circuit outages
- Credible 138kV multiple circuit outages
- Critical circuits initially out of service with system operating acceptably followed by a subsequent outage.

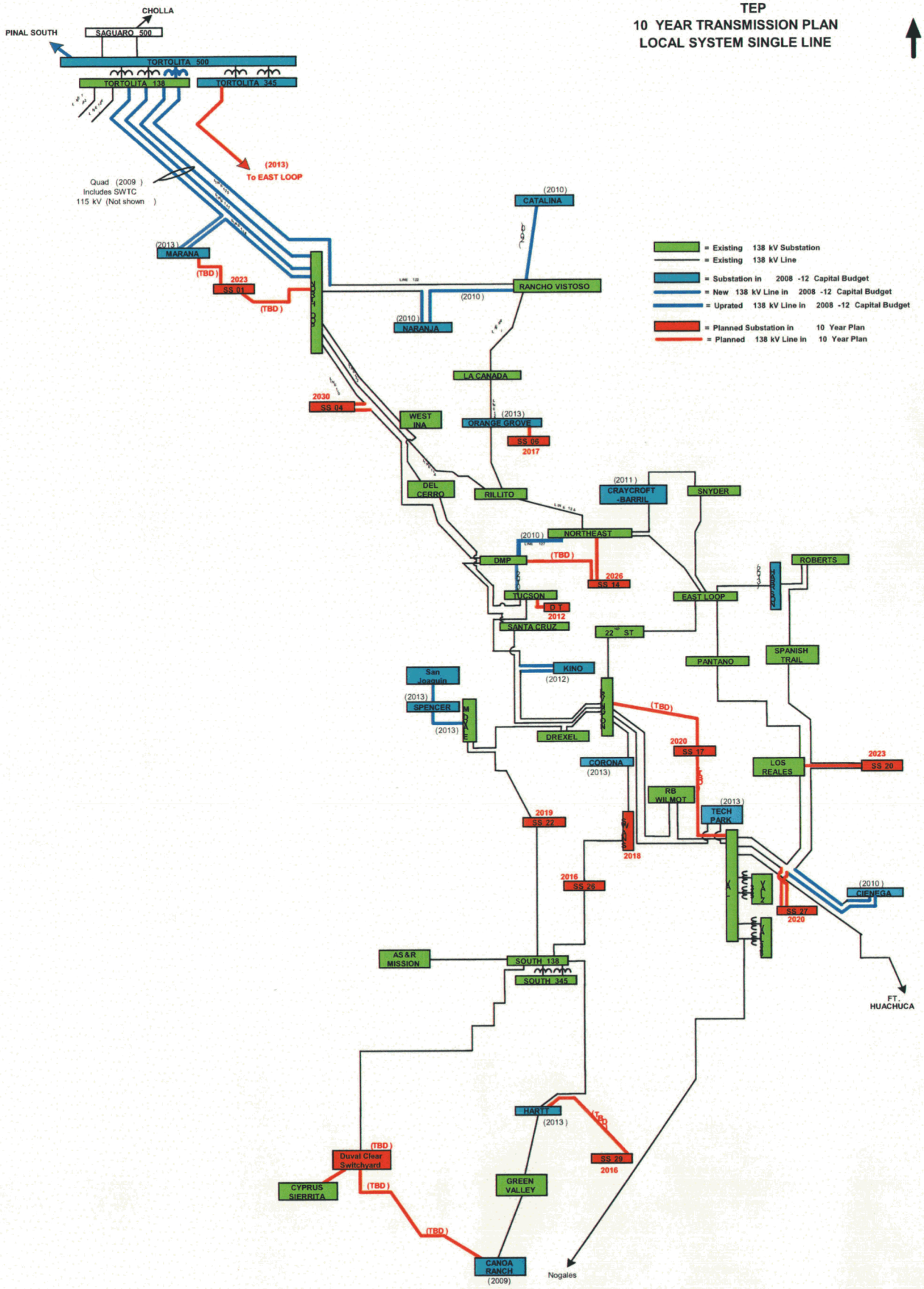
Thermal overloads are addressed with:

- New transmission lines
- Uprating existing lines (increase NESC clearances or larger ampacity wire)
- New generation (when more economical than transmission)
- Other cost effective measures

Transmission facilities are also added at 138kV to increase reliability at substations that are served radially.

TEP is in the process of installing a -75 to +200 MVAr Static Var Ccompensator at its Northeast 138 kV substation scheduled to be in-service by the summer of 2008.


Springerville
Westwing
Pinnacle Peak
Palo Verde / Hassayampa
Liberty
Browning
Silver King
Jojoba
Kyrene
TBD
Pinal West 2008
Santa Rosa
Southeast Station
Greenlee
Greenlee / SWTC
Proposed Pinal South
Morenci
North Gila
2011
Saguaro
Dos Condados
Tortolita
TBD
North Loop
East Loop
Winchester
2015
TBD
TBD
Red Tail
TBD
South
Vail
TBD
TBD
Bicknell
Pantano
Butterfield
Apache
TBD
Gateway
TBD
CFE
TBD
LEGEND
500 kV
345 kV
230 kV
Facilities Proposed by TEP
Jointly Proposed Facilities
Facilities Proposed by Others


TEP
10 YEAR TRANSMISSION PLAN
LOCAL SYSTEM SINGLE LINE
CHOLLA
PINAL SOUTH
SAGUARO 500
TORTOLITA 500
TORTOLITA 138
TORTOLITA 345
(2013)
To EAST LOOP
Quad (2009)
Includes SWTC
115 kV (Not shown)
(2010)
CATALINA
(2013)
MARANA
(TBD)
2023
SS 01
(TBD)
RANCHO VISTOSO
(2010)
(2010)
NARANJA
LA CANADA
2030
SS 04
WEST INA
(2013)
ORANGE GROVE
SS 06
2017
DEL CERRO
RILLITO
(2011)
CRAYCROFT -BARRIL
SNYDER
(2010)
NORTHEAST
DMP
(TBD)
2026
SS 18
ROBERTS
TUCSON
D T
2012
EAST LOOP
SANTA CRUZ
22 ST
PANTANO
SPANISH TRAIL
San Joaquin
(2013)
SPENCER
(2013)
KINO
(2012)
(TBD)
DREXEL
2020
SS 17
CORONA
(2013)
LOS REALES
2023
SS 20
RB WILMOT
(2013)
TECH PARK
2019
SS 22
2018
2016
SS 26
(2010)
CIENEGA
SS 27
2020
AS&R MISSION
SOUTH 138
SOUTH 345
FT. HUACHUCA
HARTT
(2013)
(TBD)
SS 29
2016
(TBD)
Duval Clear Switchyard
CYPRUS SIERRITA
(TBD)
GREEN VALLEY
(TBD)
CANOA RANCH
(2009)
Nogales
= Existing 138 kV Substation
= Existing 138 kV Line
= Substation in 2008 -12 Capital Budget
= New 138 kV Line in 2008 -12 Capital Budget
= Uprated 138 kV Line in 2008 -12 Capital Budget
= Planned Substation in 10 Year Plan
= Planned 138 kV Line in 10 Year Plan

TUCSON ELECTRIC POWER COMPANY

10 YEAR PLAN

TRANSMISSION FACILITIES

Line Designation	Interconnection of Westwing – South 345 kV with future Hassyampa – Pinal West 500 kV line[i] via new Pinal West 500/345 kV Substation
Size	
a) Voltage	345-kV
b) Capacity	System dependent
c) Point of Origin	Westwing – South Line
d) Point of Termination	Future Pinal West substation (Sec. 6 T5S R1E)
e) Length	Less than 1 mile
Routing	Adjacent to Westwing – South 345 kV line.
Purpose	To reinforce TEP's EHV system and to provide a higher capacity link for the flow of power from the Palo Verde area into TEP's service territory.
Date	
a) Construction Start	2007
b) In-Service Date	2008
Is Certificate Necessary	Case #124
Technical Studies	Studies completed via CATS, WATS, and Palo Verde – Southeast Station study groups.

[i] A joint project being jointly developed with SRP as project manager

TUCSON ELECTRIC POWER COMPANY

10 YEAR PLAN

TRANSMISSION FACILITIES

Line Designation	Pinal South Substation to Tortolita Substation
Size	
a) Voltage	500-kV
b) Capacity	System dependent
c) Point of Origin	Future Pinal South substation
d) Point of Termination	Tortolita Substation (Sec. 14 T10S R10E)
e) Length	Approximately 30 miles
Routing	Unknown
Purpose	To reinforce TEP's EHV system and to provide a higher capacity link for the flow of power from the Palo Verde area into TEP's northern service territory.
Date	
a) Construction Start	2010
b) In-Service Date	2011
Is Certificate Necessary	Yes
Technical Studies	Studies in progress via SWAT and internal TEP study efforts.

TUCSON ELECTRIC POWER COMPANY

10 YEAR PLAN

TRANSMISSION FACILITIES

Line Designation	Tortolita Substation to Vail Substation (through North Loop and East Loop Substations)	
Size		
a) Voltage	345-kV	
b) Capacity	System dependent	
c) Point of Origin	Tortolita Substation (Sec. 14 T10S R10E)	
d) Point of Termination	Vail Substation (Sec. 4 T16S R15E)	
e) Length	Approximately 60 miles	
Routing	Unknown	
Purpose	To reinforce TEP's EHV system and to provide a new tie between TEP's HV and EHV systems.	
Date		
a) Construction Start	2013	
b) In-Service Date	Phase 1 - 2014	Tortolita Substation to North Loop Substation
	Phase 2 - Under Review	North Loop Substation to East Loop Substation
	Phase 3 - Under Review	East Loop Substation to Vail Substation
Is Certificate Necessary	Yes	
Technical Studies	Studies in progress via SWAT and internal TEP study efforts.	

TUCSON ELECTRIC POWER COMPANY

10 YEAR PLAN

TRANSMISSION FACILITIES

Line Designation	Tortolita Substation to Winchester Substation
Size	
a) Voltage	500-kV
b) Capacity	System dependent
c) Point of Origin	Tortolita Substation (Sec. 14 T10S R10E)
d) Point of Termination	Winchester Substation
e) Length	Approximately 80 miles
Routing	As described in Siting Case No. 23
Purpose	To reinforce TEP's EHV system and to provide a higher capacity link for the flow of power from the Palo Verde area into TEP's eastern transmission system.
Date	
a) Construction Start	Under Review
b) In-Service Date	Under Review
Is Certificate Necessary	Case No. 23
Technical Studies	Studies in progress via SWAT and internal TEP study efforts.

TUCSON ELECTRIC POWER COMPANY

10 YEAR PLAN

TRANSMISSION FACILITIES

Line Designation	Winchester Substation to Vail Substation – 2nd circuit
Size	
a) Voltage	345-kV
b) Capacity	System dependent
c) Point of Origin	Winchester Substation
d) Point of Termination	Vail Substation (Sec. 4 T16S R15E)
e) Length	Approximately 40 miles
Routing	Parallel to existing Winchester – Vail Line
Purpose	To reinforce TEP's EHV system and to provide additional transmission capacity from the future Winchester Station into Tucson
Date	
a) Construction Start	Under Review
b) In-Service Date	Under Review
Is Certificate Necessary	Yes
Technical Studies	Studies in progress via SWAT and internal TEP study efforts.

TUCSON ELECTRIC POWER COMPANY

10 YEAR PLAN

TRANSMISSION FACILITIES

Line Designation	Vail Substation to South Substation – 2nd circuit
Size	
a) Voltage	345-kV
b) Capacity	System dependent
c) Point of Origin	Vail Substation (Sec. 4 T16S R15E)
d) Point of Termination	South Substation (Sec. 36 T16S R13E)
e) Length	14 miles
Routing	Parallel to existing Vail – South Line
Purpose	To reinforce TEP's EHV system and to provide additional transmission capacity between Vail and South Substations
Date	
a) Construction Start	Under Review
b) In-Service Date	Under Review
Is Certificate Necessary	No
Technical Studies	Studies in progress via SWAT and internal TEP study efforts.

TUCSON ELECTRIC POWER COMPANY

10 YEAR PLAN

TRANSMISSION FACILITIES

Line Designation	Springerville Substation to Greenlee Substation - 2nd circuit
Size	
a) Voltage	345-kV
b) Capacity	System dependent
c) Point of Origin	Springerville Substation (Sec. 34 T11N R30E)
d) Point of Termination	Greenlee Substation (Sec. 29 T5S R31E)
e) Length	110 Miles total; 27 Miles in Arizona.
Routing	Parallel to existing Springerville to Greenlee line.
Purpose	To deliver power and energy from major TEP interconnections in the Four Corners and Eastern Arizona regions.
Date	
a) Construction Start	Under Review
b) In-Service Date	Under Review
Is Certificate Necessary	Issued in 1975, 1977, 1982 and 1986
Technical Studies	Studies conducted in coordination with neighboring utilities formed the basis for the design of TEP's original EHV system in the 70's. This project is based on that original work. Detailed studies will be developed in the future upon a determination of need for this project by TEP.

TUCSON ELECTRIC POWER COMPANY

10 YEAR PLAN

TRANSMISSION FACILITIES

Line Designation	Tortolita Substation to South Substation.
Size	
a) Voltage	345-kV
b) Capacity	System dependent
c) Point of Origin	Tortolita Substation (Sec. 23 T10S R10E)
d) Point of Termination	South Substation (Sec. 36 T16S R13E)
e) Length	68 Miles
Routing	From Tortolita Substation south through Avra Valley to existing Westwing-South 345-kV transmission line right-of-way, then parallel to existing Westwing – South line to South Substation.
Purpose	To reinforce TEP's EHV system and to provide a high capacity link for the flow of power in Southern Arizona.
Date	
a) Construction Start	Under Review
b) In-Service Date	Under Review
Is Certificate Necessary	Case #50
Technical Studies	Being re-evaluated as part of SWAT study

TUCSON ELECTRIC POWER COMPANY

10 YEAR PLAN

TRANSMISSION FACILITIES

Line Designation	Westwing Substation to South Substation – 2nd circuit
Size	
a) Voltage	345-kV
b) Capacity	System dependent
c) Point of Origin	Westwing Substation (Sec. 12 T4N R1W)
d) Point of Termination	South Substation (Sec. 36 T16S R13E)
e) Length	178 Miles
Routing	Parallel to existing Westwing to South line.
Purpose	To deliver power and energy from major TEP interconnections in the Northwest Phoenix region.
Date	
a) Construction Start	Under Review
b) In-Service Date	Under Review
Is Certificate Necessary	Case # 15
Technical Studies	Studies conducted in coordination with neighboring utilities formed the basis for the design of TEP's original EHV system in the 70's. This project is based on that original work. Detailed studies will be developed in the future upon a determination of need for this project by TEP.

TUCSON ELECTRIC POWER COMPANY

10 YEAR PLAN

TRANSMISSION FACILITIES

Line Designation	TEP-Unisource Energy Services 345 kV Interconnection Line--South Substation to future Gateway Substation (2 ckts.)
Size	
a) Voltage	345-kV
b) Capacity	500 MW
c) Point of Origin	South Substation (Sec. 36 T16S R13E)
d) Points of Termination	Gateway Substation in (Sec. 12 T24S R13E)
e) Length	Approximately 60 Miles
Routing	Southerly from South Substation, near Sahuarita Arizona to Nogales area.
Purpose	To provide an alternate transmission path to UNS Electric in Nogales, Arizona pursuant to ACC Order.
Date	
a) Construction Start	Dependent upon permitting
b) In-Service Date	Dependent upon permitting
Is Certificate Necessary	Case #111
Technical Studies	See record of Siting Case No. 111

TUCSON ELECTRIC POWER COMPANY

10 YEAR PLAN

TRANSMISSION FACILITIES

Line Designation	Gateway Substation to Comision Federal de Electricidad (CFE) (2 ckts.)
Size	
a) Voltage	345-kV
b) Capacity	500 MW
c) Point of Origin	Gateway Substation (Sec. 12 T24S R13E)
d) Points of Termination	Arizona-Sonora boundary (Sec. 13 T24S R13E)
e) Length	Approximately 2 Miles
Routing	Southerly from Gateway Substation, in or near the Nogales area.
Purpose	To interconnect to the Comision Federal de Electricidad in Sonora, Mexico.
Date	
a) Construction Start	Dependent upon permitting
b) In-Service Date	Dependent upon permitting
Is Certificate Necessary	Case #111
Technical Studies	See record of Siting Case No. 111

TUCSON ELECTRIC POWER COMPANY

10 YEAR PLAN

TRANSMISSION FACILITIES

Line Designation	Irvington Substation to East Loop Substation (through 22nd Street Substation).	
Size		
a) Voltage	138-kV	
b) Capacity	System dependent	
c) Point of Origin	Irvington Substation (Sec. 03 T15S R14E)	
d) Point of Termination	East Loop Substation (Sec. 08 T14S R15E)	
e) Length	9 Miles	
Routing	North and East of Irvington Substation, through 22nd Street Substation, then East and North to East Loop Substation.	
Purpose	To provide additional electric service to the central area of TEP's service area and to reinforce the local transmission system.	
Date		
a) Construction Start	1985	
b) In-Service Date	Phase 1 - 1994 (Completed)	Irvington Station to 22nd St. Substation
	Phase 2 - 2000 (Completed)	22nd St. to East Loop Substation
	Phase 3 - Under Review	2nd Circuit of Phase I
Is Certificate Necessary	Case #66	

TUCSON ELECTRIC POWER COMPANY

10 YEAR PLAN

TRANSMISSION FACILITIES

Line Designation		Vail Substation to East Loop Substation (through Houghton Loop Switching Station*, Spanish Trail and Roberts Substations), tapping the Roberts-East Loop line for new Harrison substation.
Size		
	a) Voltage	138-kV
	b) Capacity	System dependent
	c) Point of Origin	Vail Substation (Sec. 4 T16S R15E)
	d) Point of Termination	East Loop Substation (Sec. 8 T14S R15E)
	e) Length	22 Miles
Routing		East and north from Vail Substation along existing transmission line to Irvington and Houghton Roads, then north along Houghton Road to Speedway Boulevard, then east and north to Roberts Substation and west along Speedway to East Loop Substation.
Purpose		To provide additional electric service to the eastern portion of TEP's service area and to reinforce the local transmission system.
Date		
	a) Construction Start	1976
	b) In-Service Date	Phase 1 - 1977 (Completed) — Spanish Trail Substation to East Loop and Vail Substation
		Phase 2 - 1983 (Completed) — Roberts Substation and associated 138-kV lines
		Phase 3 – Under Review — Third 138-kV line from Vail to East Loop Substation
		Phase 4 - — Harrison Substation tap of Roberts-East Loop 138 kV line
Is Certificate Necessary		Case #8

*Houghton Loop switching station has been removed from TEP's plans. Name retained for reference only.

TUCSON ELECTRIC POWER COMPANY

10 YEAR PLAN

TRANSMISSION FACILITIES

Line Designation	East Loop Substation to Northeast Substation (through Snyder Substation)
Size	
a) Voltage	138-kV
b) Capacity	System dependent
c) Point of Origin	East Loop Substation Sec. (8 T14S R15E)
d) Point of Termination	Northeast Substation Sec. (28 T13S R14E)
e) Length	13 Miles
Routing	North and west of East Loop Substation, then south and west to termination point.
Purpose	To provide additional electric service to the northeastern area of TEP's service area.
Date	
a) Construction Start	1985
b) In-Service Date	Phase 1 - 1987 (Completed) — Snyder Substation and 138-kV line to East Loop Substation Phase 2 – 1999-2005 — 138-kV line from Snyder Substation to Northeast Substation Interim line in service. Final completion date - dependent on Pima County completion of public improvement project along Sunrise Dr. Pima County has not set a date for completion of this work.
Is Certificate Necessary	Case #47

TUCSON ELECTRIC POWER COMPANY

10 YEAR PLAN

TRANSMISSION FACILITIES

Line Designation	Loop existing West Ina Substation to Tucson Station line through Del Cerro (formerly Sweetwater) Substation.
Size	
a) Voltage	138-kV
b) Capacity	System dependent
c) Point of Origin	Sec. 20 T13S R13E
d) Point of Termination	Sec. 20 T13S R13E
e) Length	Less than one mile
Routing	Loop existing line at Camino del Cerro and Santa Cruz River; east along Camino del Cerro alignment into future Del Cerro Substation. Sec. 17 T13S R13E
Purpose	To provide additional electric service to the western part of TEP's service area and to reinforce the local distribution system.
Date	
a) Construction Start	2007
b) In-Service Date	2008
Is Certificate Necessary	Case #62

TUCSON ELECTRIC POWER COMPANY

10 YEAR PLAN

TRANSMISSION FACILITIES

Line Designation	Loop existing Vail Substation to East Loop Substation line through future Pantano and Los Reales Substations.
Size	
a) Voltage	138-kV
b) Capacity	System dependent
c) Point of Origin	Phase 1: Sec. 24, T15S R15E Phase 2: Sec. 28, T14S R15E
d) Point of Termination	Phase 1: Sec. 24, T15S R15E Phase 2: Sec. 28, T14S R15E
e) Length	Substations are less than one span from the existing line.
Routing	Phase 1 Loop existing line east of Houghton Road and south of Valencia Road through Los Reales Substation. Phase 2 Loop existing line east of Pantano Road and south of Golf Links through Pantano Substation.
Purpose	To provide additional electric service to the eastern part of TEP's service area and to reinforce the local distribution system.
Date	
a) Construction Start	Phase 1 - 2001 Phase 2 - 2006
b) In-Service Date	Phase 1 - Completed Phase 2 Completed
Is Certificate Necessary	No

TUCSON ELECTRIC POWER COMPANY

10 YEAR PLAN

TRANSMISSION FACILITIES

Line Designation	Extend 138-kV line from Midvale Substation through future Spencer Switchyard to future San Joaquin Substation.
Size	
a) Voltage	138-kV
b) Capacity	System dependent
c) Point of Origin	Midvale Substation (Sec. 3 T15S R13E)
d) Point of Termination	Future San Joaquin Substation (physical location to be determined)
e) Length	Approximately 20 miles
Routing	Reviewing use of common utility corridor and existing subtransmission
Purpose	To provide additional electrical service to the far western portion of TEP's service area and to reinforce the local distribution system.
Date	
a) Construction Start	2012
b) In-Service Date	2013
Is Certificate Necessary	Under Review (dependent upon use of federal and/or Tohono r/w)

TUCSON ELECTRIC POWER COMPANY

10 YEAR PLAN

TRANSMISSION FACILITIES

Line Designation	South Substation to Duval CLEAR Switchyard (formerly Cyprus Sierrita Extension Switchyard) through future Canoa Ranch (formerly Desert Hills) Substation and Green Valley Substation	
Size		
a) Voltage	138-kV	
b) Capacity	System dependent	
c) Point of Origin	South Substation (Sec. 36 T16S R13E)	
d) Point of Termination	Duval CLEAR Switchyard (formerly Cyprus-Sierrita Extension Switchyard) (Sec. 10 T18S R12E)	
e) Length	Approximately 24 miles	
Routing	Uses existing transmission, sub-transmission, and overhead distribution route.	
Purpose	To provide additional electrical service to southern area of TEP's service area and to reinforce the local transmission & distribution system.	
Date		
a) Construction Start	1995	
b) In-Service Date	Phase 1 -1997 (Completed)	South 138-kV line to Green Valley.
	Phase 2a -2006 (Completed)	138-kV line from Green Valley to future Canoa Ranch Substation site
	Phase 2b- 2013	Extend 138-kV line from Canoa Ranch Substation site to future Duval CLEAR Switchyard (formerly Cyprus Sierrita Extension Switchyard)
Is Certificate Necessary	Case 84 (Extension approved in 2006 ACC Order # 69680, docketed 6/28/07)	

TUCSON ELECTRIC POWER COMPANY

10 YEAR PLAN

TRANSMISSION FACILITIES

Line Designation	Rancho Vistoso Substation to future Catalina Substation
Size	
a) Voltage	138-kV
b) Capacity	System dependent
c) Point of Origin	Rancho Vistoso Substation (Sec. 36 T11S R13E)
d) Point of Termination	Future Catalina Substation Sec. 18 T11S R14E
e) Length	Approximately 3.5 Miles
Routing	Existing Western Area Power Administration corridor
Purpose	To provide additional electrical service to far northern area of TEP's service area and to reinforce the local distribution system.
Date	
a) Construction Start	2009
b) In-Service Date	2010
Is Certificate Necessary	No

TUCSON ELECTRIC POWER COMPANY

10 YEAR PLAN

TRANSMISSION FACILITIES

Line Designation	Loop existing Irvington Station to Vail Substation #2 line through future University of Arizona Tech Park Substation.
Size	
a) Voltage	138-kV
b) Capacity	System dependent
c) Point of Origin	Vail – Irvington Corridor
d) Point of Termination	Future U of A Tech Park Substation approximately Sec. 28 T15S R15E
e) Length	Approximately 5 miles of double-circuited line
Routing	Loop existing Irvington – Vail #2 line into future U of A Tech Park substation
Purpose	To provide additional electric service to the U of A Tech Park expansion and the southern part of TEP's service area.
Date	
a) Construction Start	2012
b) In-Service Date	2013
Is Certificate Necessary	Yes

TUCSON ELECTRIC POWER COMPANY

10 YEAR PLAN

TRANSMISSION FACILITIES

Line Designation	Tortolita Substation – Rillito Substation 138 kV
Size	
a) Voltage	138-kV
b) Capacity	System dependent
c) Point of Origin	Tortolita 138 kV Substation
d) Point of Termination	Rillito 138 kV Substation
e) Length	24.5 miles
Routing	Unknown
Purpose	Required to fully utilize increased import capability of additional EHV capacity into Tortolita Substation (Pinal South – Tortolita).
Date	
a) Construction Start	Under review
b) In-Service Date	Under review
Is Certificate Necessary	Yes

TUCSON ELECTRIC POWER COMPANY

10 YEAR PLAN

TRANSMISSION FACILITIES

Line Designation	Tortolita Substation – North Loop Substation, North Loop Substation – Rancho Vistoso Substation and Tortolita – Rancho Vistoso 138 kV corridor expansion and reconfiguration
Size	
a) Voltage	138-kV
b) Capacity	System dependent
c) Points of Origin	Tortolita 138 kV Substation North Loop 138 kV Substation
d) Points of Termination	North Loop 138 kV Substation Rancho Vistoso 138 kV Substation
e) Length	Tortolita – North Loop: ~14.3 miles North Loop – Rancho Vistoso: ~11.1 miles
f) Routing	Phase 1: Re-configure Tortolita – Rancho Vistoso line as a third Tortolita - North Loop line utilizing existing 138 kV stub out of North Loop. Build new bay at North Loop to accommodate North Loop – Rancho Vistoso line utilizing existing 138 kV pole-line along Tangerine Rd. Phase 2: A joint project with SWTC to construct a new four-circuit pole-line to replace existing single-circuit structures on the Tortolita-North Loop 138 kV corridor. The four-circuit structures will accommodate the two existing Tortolita-North Loop lines, a fourth Tortolita – North Loop line and SWTC's Saguaro – Camino de Manana 115 kV circuit. Phase 3: Re-route the third Tortolita – North Loop line from Phase 1 above to terminate at Rancho Vistoso; ~ 9.0 miles of

existing 46 kV sub-transmission North Loop - Rancho Vistoso line to supply the	Rancho Vistoso; ~ 9.0 miles of along Tangerine Rd. will be uprated to 138 kV. Tap the new Naranja 138/13.8 kV substation
Purpose	Required for NERC N-1 issues on these parallel path circuits.
Date	
f) Construction Start	2008
g) In-Service Date	Phase 1: 2008 Phase 2: 2009 Phase 3: 2010
Is Certificate Necessary	Phase 1: Yes Phase 2: Yes

TUCSON ELECTRIC POWER COMPANY

10 YEAR PLAN

TRANSMISSION FACILITIES

Line Designation		Vail Substation – SS NO27 Substation- Cienega Substation – SS NO20 Substation- Spanish Trail Substation 138 kV
Size		
	a) Voltage	138-kV
	b) Capacity	System dependent
	c) Point of Origin	Vail 138 kV Substation
	d) Point of Termination	Spanish Trail 138 kV Substation
	e) Length	Phase 1: Vail – Cienega ~12.2miles Phase 2: Vail - SSNO27 ~5.3 miles Phase 3: Cienega – SS NO20 ~14.0 miles
Routing		Phase 1: Utilize the existing Vail-Fort Huachuca/ Vail-Spanish Trail 138 kV corridor between Vail Substation and seven spans east of Wentworth Rd., then new double-circuit 138 kV northeast ~2.0 miles to proposed Cienega site in T16S R16E Sec 16. Phase 2: Tap the Vail – Cienega 138 kV line from Phase 1 and extend new double-circuit 138kV ~ 2.0 miles south along Houghton Rd. to proposed SS NO27 substation site. Phase 3: Tap the Cienega – Spanish Trail line from Phase 1 and new circuit out of Los Reales extended via new triple-circuit 138kV east of Los Reales ~ 3.0 miles east along Los Reales Rd to proposed SS NO20 substation site ~ 0.75 miles east of E. Old Spanish Trail.
Purpose		Required to serve load at the new Cienega 138/13.8 kV Substation located approximately 7.5 miles east-southeast of the Vail Substation, and the future SS NO27 and SS NO20 138/13.8 kV Substations located approximately 4.0 miles southwest and 6.0 miles north of the Cienega Substation, respectively.
Date		Phase 1: Cienega a) Construction Start 2008 b) In-Service Date 2010 Phase 2: SS NO27 a) Construction Start 2018 b) In-Service Date 2020

	Phase 3: SS NO20 a) Construction Start 2021 b) In-Service Date 2023
Is Certificate Necessary	Yes

TUCSON ELECTRIC POWER COMPANY

10 YEAR PLAN

TRANSMISSION FACILITIES

Line Designation	New Cienega Substation – Mountain View Substation 138 kV Circuit and Vail Substation – Fort Huachuca Tap for Mountain View Substation
Size	
a) Voltage	138-kV
b) Capacity	System dependent
c) Point of Origin	Cienega 138 kV Substation (T16S R16E Sec 16)
d) Point of Termination	Mountain View 138 kV Substation (T17S R16E Sec 2)
e) Length	4.7 miles
Routing	Extend 138 kV pole-line out of the Cienega substation east along Dawn Dr. to the Southern Pacific Railroad, then southeast along railroad, then south to the Mountain View Substation site. In addition the Mountain View substation will tap the existing Vail Substation – Ft. Huachuca Substation line to increase reliability to Mountain View with a modest improvement in voltage regulation to Ft. Huachuca.
Purpose	Required to serve load at the new Mountain View 138/13.8 kV Substation approximately 11 miles south-southeast of the Vail Substation
Date	
a) Construction Start	TBD
b) In-Service Date	TBD
Is Certificate Necessary	Yes

TUCSON ELECTRIC POWER COMPANY

10 YEAR PLAN

TRANSMISSION FACILITIES

Line Designation	Northeast – Snyder 138 kV – tap for Craycroft-Barril substation
Size	
a) Voltage	138-kV
b) Capacity	System dependent
c) Point of Origin	Northeast 138 kV Substation
d) Point of Termination	Snyder 138 kV Substation
e) Length	8.0 miles
Routing	Existing Northeast-Snyder Corridor requires 1 span of wire to drop into station.
Purpose	Required to serve load at the new Craycroft-Barril 138/13.8 kV Substation locate approximately 2.75 miles northeast of the Northeast Substation
Date	
a) Construction Start	2010
b) In-Service Date	2011
Is Certificate Necessary	No

TUCSON ELECTRIC POWER COMPANY

10 YEAR PLAN

TRANSMISSION FACILITIES

Line Designation	Irvington - Tucson 138 kV - tap for Kino Substation
Size	
a) Voltage	138-kV
b) Capacity	System dependent
c) Point of Origin	Irvington 138 kV Substation
d) Point of Termination	Tucson 138 kV Substation
e) Length	10.9 miles
Routing	Existing Irvington-Tucson Corridor And ~ 3.0 miles of new double-circuit corridor north of Drexel along Kino Parkway to 36th St.
Purpose	Required to serve load at the new Kino 138/13.8 kV Substation located approximately 5.0 miles northwest of the Irvington Substation
Date	
a) Construction Start	2010
b) In-Service Date	2012
Is Certificate Necessary	Yes

TUCSON ELECTRIC POWER COMPANY

10 YEAR PLAN

TRANSMISSION FACILITIES

Line Designation	Tortolita Substation – Marana Substation – North Loop Substation 138 kV and Marana Substation – SS NO1 Substation -North Loop Substation 138 kV
Size	
a) Voltage	138-kV
b) Capacity	System dependent
c) Point of Origin	Phase 1: Tortolita 138 kV Substation Phase 2: Marana 138 kV Substation
d) Point of Termination	North Loop 138 kV Substation
e) Length	Phase 1: Tortolita – Marana ~11.0 miles Marana - North Loop ~11.0 miles Phase2: Marana – SSNO1 ~6.0 miles SSNO1 – North Loop ~7.5 miles
Routing	Phase 1: Tap the Tortolita- North Loop corridor at the Trico-Marana Rd. alignment and extend ~ 4 miles of double-circuit pole-line west across I-10 to proposed Marana substation site near Sanders Rd. Phase 2: approximately 13.5 miles of new corridor between Marana and Tortolita 138 kV substations located west of I-10
Purpose	Phase 1:Required to serve load at the new Marana 138/13.8 kV Substation located approximately 9.0 miles south-southeast of the Tortolita Substation Phase 2: Required to serve load at the new SS NO1 138/13.8 kV Substation located approximately 6.0 miles south-southeast of the Marana Substation
Date	
Marana (Phase 1)	a) Construction Start 2011 b) In-Service Date 2013
SS NO1 (Phase 2)	a) Construction Start 2021

	b) In-Service Date 2023
Is Certificate Necessary	Yes

TUCSON ELECTRIC POWER COMPANY

10 YEAR PLAN

TRANSMISSION FACILITIES

Line Designation	North Loop Substation - Rancho Vistoso Substation 138kV tap for new Naranja Substation
Size	
a) Voltage	138-kV
b) Capacity	System dependent
c) Point of Origin	North Loop 138 kV Substation
d) Point of Termination	Naranja 138 kV Substation
e) Length	North Loop – Naranja ~7.9 miles Naranja – Ranch Vistoso ~16.6 miles
Routing	Tap the North Loop – Rancho Vistoso line created as part of the Tortolita Substation – North Loop Substation and North Loop Substation – Rancho Vistoso Substation 138 kV corridor expansion and reconfiguration project. Extend ~ 3.0 miles of new double circuit corridor south of Tangergine Rd. along Thornydale Rd. to the substation site
Purpose	Required to serve load at the new Naranja 138/13.8 kV Substation located in the vicinity of Thornydale Rd. and Lambert Ln.
Date	
a) Construction Start	2009
b) In-Service Date	2010
Is Certificate Necessary	Yes

TUCSON ELECTRIC POWER COMPANY

10 YEAR PLAN

TRANSMISSION FACILITIES

Line Designation	DeMoss Petrie Substation – Tucson Substation 138 kV
Size	
a) Voltage	138-kV
b) Capacity	System dependent
c) Point of Origin	DeMoss Petrie 138 kV Substation
d) Point of Termination	Tucson 138 kV Substation
e) Length	4.5 miles
Routing	existing DeMoss Petrie – Tucson 46 kV corridor
Purpose	Required to eliminate localized voltage instability specific to loss of both the North Loop-West Ina and Irvington-Tucson 138 kV circuits. By 2010, the existing 46 kV tie between DMP and Tucson Stations is unable to support voltage of the Tucson and West Ina load during this contingency.
Date	
a) Construction Start	2009
b) In-Service Date	2010
Is Certificate Necessary	Yes

TUCSON ELECTRIC POWER COMPANY

10 YEAR PLAN

TRANSMISSION FACILITIES

Element Designation	Northeast 138 kV Static Var Compensator (SVC)
Size	
a) Voltage	138-kV
b) Capacity	-75 to +200 MVAr
c) Location	Northeast 138 kV Substation
Purpose	The SVC is being installed to reduce, and in some cases eliminate, the need for direct load tripping required for stable operation during system contingencies. As a dynamic VAr source, the SVC also reduces the amount of generation that would otherwise have to run to provide these dynamic VArs
Date	
a) Construction Start	2007 - project underway
b) In-Service Date	2008
Is Certificate Necessary	No

Study work used to justify the SVC attached as Appendix A:

Voltage Stability Study of the Tucson Electric Power 138 kV System, 8/19/05

Voltage Stability Study of the Tucson Electric Power 138 kV System Phase II , 10/4/06

TUCSON ELECTRIC POWER COMPANY

10 YEAR PLAN

TRANSMISSION FACILITIES

Line Designation	North Loop Substation – SS NO4 Substation– DeMoss Petrie Substation 138kV
Size	
a) Voltage	138-kV
b) Capacity	System dependent
c) Point of Origin	North Loop 138 kV Substation
d) Point of Termination	DeMoss Petrie Substation
e) Length	North Loop – SS NO4 ~4.5 miles SS NO4 – DeMoss Petrie ~11.3 miles
Routing	Tapping the existing North Loop - West Ina 138kV circuit and extending approximately 2 miles of new double circuit pole-line southwest along Cortaro Farms Rd. to the substation site.
Purpose	Required to serve load at the new SS NO4 138/13.8 kV Substation
Date	
a) Construction Start	2028
b) In-Service Date	2030
Is Certificate Necessary	Yes

TUCSON ELECTRIC POWER COMPANY

10 YEAR PLAN

TRANSMISSION FACILITIES

Line Designation	Midvale Substation – SS NO22 Substation– South Substation 138kV
Size	
a) Voltage	138-kV
b) Capacity	System dependent
c) Point of Origin	Midvale 138 kV Substation
d) Point of Termination	South 138kV Substation
e) Length	Midvale – SS NO22 ~6.0 miles SS NO22 – South ~7.0 miles
Routing	Tapping the existing Midvale - South 138kV circuit
Purpose	Required to serve load at the new SS NO22 138/13.8 kV Substation
Date	
a) Construction Start	2017
b) In-Service Date	2019
Is Certificate Necessary	Yes

TUCSON ELECTRIC POWER COMPANY

10 YEAR PLAN

TRANSMISSION FACILITIES

Line Designation	Irvington Substation – Corona Substation –Swan Southlands Substation – SS NO26 Substation – South Substation 138kV
Size	
a) Voltage	138-kV
b) Capacity	System dependent
c) Point of Origin	Irvington 138 kV Substation
d) Point of Termination	South 138kV Substation
e) Length	Phase 1: Irvington – Corona ~3.0 miles Corona – South ~13.1 miles Phase 2: Corona – SS NO26 ~7.0miles SS NO26 – South ~6.1 miles Phase 3: Corona – Swan Southlands ~13.1 miles Swan South – SS NO26 ~3.0 miles
Routing	Tapping the existing Irvington – South 138kV circuit.
Purpose	Phase 1: Required to serve load at the new Corona 138/13.8 kV Substation Phase 2: Required to serve load at the new SS NO26 138/13.8 kV Substation Phase 3: Required to serve load at the new Swan Southlands 138/13.8 kV Substation
Date	Phase 1: Corona a) Construction Start 2011 b) In-Service Date 2013 Phase 2: SS NO26 a) Construction Start 2014 b) In-Service Date 2016 Phase 3: Swan Southlands

	a) Construction Start 2016 b) In-Service Date 2018
Is Certificate Necessary	Yes

TUCSON ELECTRIC POWER COMPANY

10 YEAR PLAN

TRANSMISSION FACILITIES

Line Designation	La Canada Substation – Orange Grove Substation–Rillito Substation 138kV
Size	
a) Voltage	138-kV
b) Capacity	System dependent
c) Point of Origin	La Canada 138 kV Substation
d) Point of Termination	Rillito 138kV Substation
e) Length	La Canada – Orange Grove ~3.8 miles Orange Grove – Rillito ~1.6 miles
Routing	Tapping the existing La Canada - Rillito 138kV circuit and drop into new station adjacent to the right-of-way at La Canada Blvd. and Orange Grove Rd.
Purpose	Required to serve load at the new Orange Grove 138/13.8 kV Substation
Date	
a) Construction Start	2011
b) In-Service Date	2013
Is Certificate Necessary	Yes

TUCSON ELECTRIC POWER COMPANY

10 YEAR PLAN

TRANSMISSION FACILITIES

Line Designation	Orange Grove Substation– SS NO6 Substation 138kV
Size	
a) Voltage	138-kV
b) Capacity	System dependent
c) Point of Origin	Orange Grove 138 kV Substation
d) Point of Termination	SS NO6 138kV Substation
e) Length	Orange Grove – SS NO6 ~3.6 miles
Routing	Radial 138kV circuit from Orange Grove to SS NO6
Purpose	Required to serve load at the new SS NO6 138/13.8 kV Substation
Date	
a) Construction Start	2015
b) In-Service Date	2017
Is Certificate Necessary	Yes

TUCSON ELECTRIC POWER COMPANY

10 YEAR PLAN

TRANSMISSION FACILITIES

Line Designation	South Substation – Hartt Substation– Green Valley Substation 138kV
Size	
a) Voltage	138-kV
b) Capacity	System dependent
c) Point of Origin	South 138 kV Substation
d) Point of Termination	Green Valley 138kV Substation
e) Length	South – Hartt ~11.0 miles Hartt – Green Valley ~3.5 miles
Routing	Tapping the existing South – Green Valley 138kV circuit and drop into new station adjacent to the right-of-way ~ 1 mile south of Old Nogales Hywy and Duval Mine Rd.
Purpose	Increase load serving and reliability of existing 46/13.8 facilities near this site.
Date	
a) Construction Start	2011
b) In-Service Date	2013
Is Certificate Necessary	Yes

TUCSON ELECTRIC POWER COMPANY

10 YEAR PLAN

TRANSMISSION FACILITIES

Line Designation	Hartt Substation– SS NO29 Substation 138kV
Size	
a) Voltage	138-kV
b) Capacity	System dependent
c) Point of Origin	Hartt 138 kV Substation
d) Point of Termination	SS NO29 138kV Substation
e) Length	Hartt – SS NO29 ~7.1 miles
Routing	Radial 138kV circuit from Hartt to SS NO29
Purpose	Required to serve load at the new SS NO29 138/13.8 kV Substation
Date	
a) Construction Start	2014
b) In-Service Date	2016
Is Certificate Necessary	Yes

TUCSON ELECTRIC POWER COMPANY

10 YEAR PLAN

TRANSMISSION FACILITIES

Line Designation	Tucson Substation- Downtown Substation 138kV
Size	
a) Voltage	138-kV
b) Capacity	System dependent
c) Point of Origin	Tucson 138 kV Substation
d) Point of Termination	Downtown 138kV Substation
e) Length	Tucson - Downtown ~1.0 mile
Routing	Radial 138kV circuit from Tucson to Downtown
Purpose	Required to serve load at the new Downtown 138/13.8 kV Substation
Date	
a) Construction Start	2010
b) In-Service Date	2012
Is Certificate Necessary	Yes

TUCSON ELECTRIC POWER COMPANY

10 YEAR PLAN

TRANSMISSION FACILITIES

Line Designation	DeMoss Petrie Substation– SS NO14 Substation – Northeast Substation 138kV
Size	
a) Voltage	138-kV
b) Capacity	System dependent
c) Point of Origin	DeMoss Petrie 138 kV Substation
d) Point of Termination	Northeast 138kV Substation
e) Length	DeMoss Petrie – SS NO14 ~7.5 miles SS NO14 – Northeast ~6.0 miles
Routing	New 138kV Construction between DeMoss Petrie and Northeast 138kV substations. SS NO14 is approximately located south-southeast of Northeast Substation.
Purpose	Required to serve load at the new SS NO14 138/13.8 kV Substation
Date	
a) Construction Start	2024
b) In-Service Date	2026
Is Certificate Necessary	Yes

TUCSON ELECTRIC POWER COMPANY

10 YEAR PLAN

TRANSMISSION FACILITIES

Line Designation	Vail Substation- SS NO17 Substation – Irvington Substation 138kV
Size	
a) Voltage	138-kV
b) Capacity	System dependent
c) Point of Origin	Vail 138 kV Substation
d) Point of Termination	Irvington 138kV Substation
e) Length	Vail – SS NO17 ~6.5 miles SS NO17 – Irvington ~3.5 miles
Routing	New 138kV Construction between Vail and Irvington 138kV substations. SS NO17 is located ~2.5 miles north of Robert Bills 138kV substation.
Purpose	Required to serve load at the new SS NO14 138/13.8 kV Substation
Date	
a) Construction Start	2018
b) In-Service Date	2020
Is Certificate Necessary	Yes

Appendix A

Static VAr Compensator Voltage Stability Studies

ABB Inc.			
Title: Voltage Stability Study of the Tucson Electric Power 138 kV System: Final Report	Dept. **Consulting**	Date 8/19/2005	Pages 83

Author(s): Pouyan Pourbeik

Reviewed/Approved by: Willie Wong

Executive Summary:

This report describes the results and recommendations of the voltage stability study performed of the Tucson Electric Power (TEP) 138 kV transmission network.

The scenarios studied are for peak load conditions between 2006 to 2010. In addition, some sensitivity analysis was performed for a peak 2015 planning horizon case. ***The intent of this study was to focus only on a minimum local generation scenario.*** A minimum TEP generation scenario was studied in which all the local generation with the exception of the large steam unit at Irvington power station (Sundt #4) was taken out of service.

Based on both steady-state and time-domain analysis, the following reactive compensation additions are required to ensure stable and reliable system operation under the minimum local TEP generation scenarios, for all possible category B and C outages on the 138 kV network and select critical 345 and 500 kV lines surrounding the TEP area:

- To increase all existing shunt capacitor banks to their maximum size through the addition of extra capacitor cans, by 2006. This means increasing the size of the capacitors at Northeast, Rillito, Tucson and Westina to 50.8 MVAr each, those at South to 50.9 MVAr each and the Northeast RAS capacitor to 52 MVAr.
- To install a +200/-75 MVAr SVC at Northeast 138 kV substation that is coordinated with all of the mechanically switched capacitor banks at that substation. As such, the existing RAS capacitor at Northeast would be switched by the SVC automatically and thus removed from RAS action.
- To incrementally add the following shunt capacitor banks from 2006 to 2015:
  - A 50.8 MVAr capacitor at Northeast in 2006.
  - A 25.4 MVAr capacitor at Roberts, and a 50.8 MVAr capacitor at North Loop and Irvington in 2009.
  - To increase the size of the Roberts 25.4 MVAr capacitor to 38.1 MVAr in 2015.

Based on a time frame of 2006 to 2010, the SVC size need only be +150/-75 MVAr. To extend the period to 2015, the SVC size should be increased to +200/-75 MVAr. Thus the largest SVC size has been quoted above to cover all the cases studied. This is because it is likely more economical to install a +200/-75 MVAr SVC to begin with rather than to attempt to add to the device in future years, or to install a smaller device first and then a second SVC. Thus, if it is the intend of TEP to be able to maintain a minimum generation scenario up to and including 2015 during peak load times, the recommended solution is a +200/-75 MVAr SVC with gradual addition of the proposed shunt capacitor banks as described above.

The above recommendations are supported by both the results of the steady-state and time-domain simulations. It is shown in the report that in order to maintain reliable system operation under various credible load modeling assumptions, the most robust solution option (with a focus on sizing the dynamic device in order to avoid exorbitant cost) is that provided above. These reactive additions are required to ensure stable system response to all category B outages on the 138 kV and surrounding EHV (345 and 500 kV) lines and transformers. For category C and higher, Remedial Action Scheme (RAS) load shedding is also required.

Both steady-state and time-domain simulations were performed to confirmed that RAS load shedding will be necessary for a number of category C outages. Power flow analysis was performed to confirm that all of the category C outages can be solved by either the proposed additional shunt compensation or the combined

application of this shunt compensation together with an appropriate amount of RAS load shedding and the application of the RAS reactor at South. Although the RAS capacitors at Vail were not used, this is not necessarily an indication that they are not needed for category C and D outages. Here the purpose of the N-2 contingency analysis was simply to illustrate that a solution can be achieved with the combination of RAS (load shedding and reactive devices) and the added reactive compensation. Therefore, we simply found a way to achieve a solution in each case. A more optimal solution may exist with the application of the RAS capacitors. The optimization of the RAS load shedding and reactive devices, for category C and D outages, is outside the scope of this study. Time-domain simulations were also performed for the most onerous category C cases to illustrate that the combination of the additional shunt compensation and RAS load shedding can indeed achieve a stable system response.

Through the N-2 contingency analysis a couple of double contingencies were identified that may warrant further investigation. One of these results in problems in the New Mexico system and the other results in severe voltage depressions in Zone 161. Since both areas are outside the study area being investigated here, no further action was taken for the purposes of this study.

Finally, it should be emphasized again that the above reactive additions are recommended for the purpose of allowing reliable system operation during peak load hours under a TEP minimum local generation scenario. Recently discussions with TEP (since late June, 2005) have identified that the propose minimum generation scenario may not be realizable as early as 2006 due to thermal and other system operating constraints. Thus, reaching the minimum generation scenario may be a more gradual process as other issues are addressed in parallel. As such, the need for the SVC (and possibly its size) as well as the exact timing of phasing in the additional shunt capacitor additions will be impacted by the actual generation dispatch scenarios to be considered. Such determinations require further analysis, and are beyond the scope of this report.

ABB Inc.			
Title: Voltage Stability Study of the Tucson Electric Power 138 kV System – Phase II: Final Report	Dept. **Consulting**	Date 10/4/2006	Pages 76

Author(s): Pouyan Pourbeik

Reviewed/Approved by: Willie Wong

Executive Summary:

This report describes the results and recommendations of the Phase II voltage stability study performed of the Tucson Electric Power (TEP) 138 kV transmission network.

In 2005, a comprehensive analysis was performed of the TEP system looking at a single generation dispatch scenario – minimum local generation (only Sundt #4 on-line). For this analysis, summer peak load cases were studied for 2006 to 2010. In addition, some sensitivity analysis was performed for a peak 2015 planning horizon case.

Based on detailed steady-state analysis (contingency analysis, PV, QV and OPF) and time-domain analysis, it was found that voltage stability concerns did exist within the TEP system for this minimum generation scenario and that the most robust solution, which would cover all cases through 2015, is a smoothly controlled dynamic reactive device. That is, a +200/-75 MVAr SVC located at Northeast substation and coordinated with four 50 MVAr capacitor banks at the same substation (these shunt banks would be essentially the existing three shunt capacitors at Northeast expanded to 2 x 50.8 MVAr and 52 MVAr, and the addition of a third 50.8 MVAr capacitor). Also, some additional mechanically switched capacitors were recommended at other substations for the purpose of ensuring adequate steady-state voltage profile and stability.

This report describes the time-domain, and some limited steady-state analysis, associated with Phase II of this study. After completion of the Phase I work in 2005, TEP proceeded to perform an extensive and comprehensive analysis of the system focusing on thermal and voltage criteria from a steady-state perspective. All N-1 and N-2 (essentially N-1-1) cases were investigated. Based on this analysis required minimum local generation scenarios (RLG) were established as well as transmission augmentation and discreet shunt compensation additions in order to address thermal and voltage criteria violations. Also, both SVC and non-SVC cases were investigated. In general, the results of the steady-state contingency analysis (performed by TEP) may be briefly summarized as follows:

- For the RLG cases established with the SVC in-service the only non-convergent power flow solutions were a few N-1-1 outages that involved the loss of the SVC as one of the outages[1]. This is clearly no surprise, since the SVC was established to ensure voltage stability.
- For the RLG cases without the SVC many N-1-1 cases result in divergent power flows, which is indicative of voltage stability concerns.
- The RLG in general tends to be less with the SVC in-service thus establishing an additional economic benefit of requiring less of the expensive local generation to be on-line for the purpose of serving load.

Based on these results, the decision has been made to move forward with the SVC option. However, to ensure that the steady-state results are indicative of the expected dynamic performance of the system some further time-domain simulations was needed; that is the purpose of this report and study.

In this study, the RLG cases established by TEP's steady-state analysis were used as a starting point. Then the

[1] Two other outages also resulted in non-convergent power flows. The loss of the Irvington – Tucson 138 kV and North Loop – West Ina 138 kV and the loss of Hidalgo – P Young 345 kV and Springerville – Luna 345 kV. As shown in previous work (such as the Phase I study) the former of these outages results in radially back-feeding a pocket of load off of the 46 kV network and the latter is related to problems in a neighboring system. Thus, these two outages were not further investigated in this study.

worst N-1 and N-1-1 outages were identified through steady-state analysis. These critical outages were then simulated in time-domain. The results of this time domain analysis confirms that:

1. The SVC is needed to ensure stability and provided for greater voltage regulation and a faster voltage recovery post-disturbance.
2. The proposed location and size of the SVC is adequate through 2015; that is, at the Northeast 138 kV substation, coordinated with the MSCs at that substation and having a rating of +200/-75 MVAr (as seen at the 138 kV level).
3. The additional proposed shunt capacitor banks (mechanically switched) as included in the TEP RLG cases for the study years is needed for steady-state voltage support.